National Aeronautics and Space Administration

NASA HQ Report

Astrophysics

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on behalf of Paul Hertz

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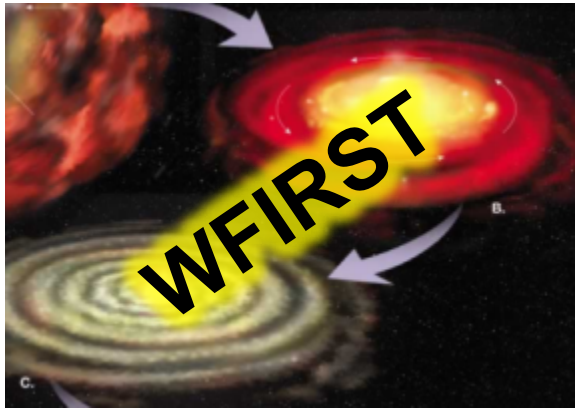
www.nasa.gov

Why Astrophysics?

Astrophysics is humankind's scientific endeavor to understand the universe and our place in it.

1. How did our universe begin and evolve?

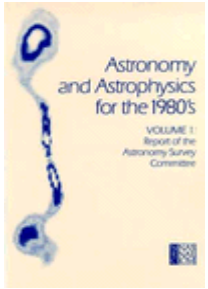


2. How did galaxies, stars, and planets come to be?

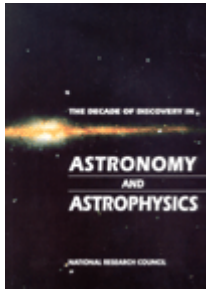
3. Are We Alone?

These national strategic drivers are enduring

1972

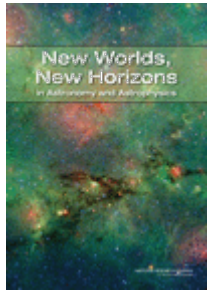


1982



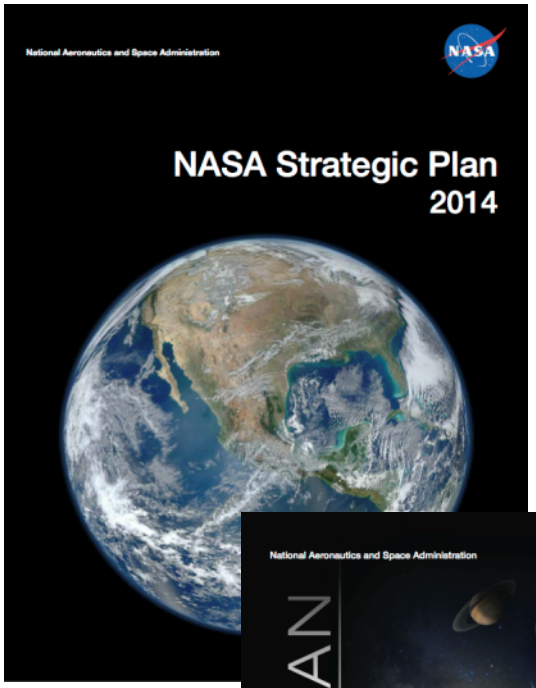
1991

2001



2010

NASA Strategic Plan



NASA Strategic Objective

Discover how the universe works, explore how it began and evolved, and search for life on planets around other stars.

SMD Science Goals

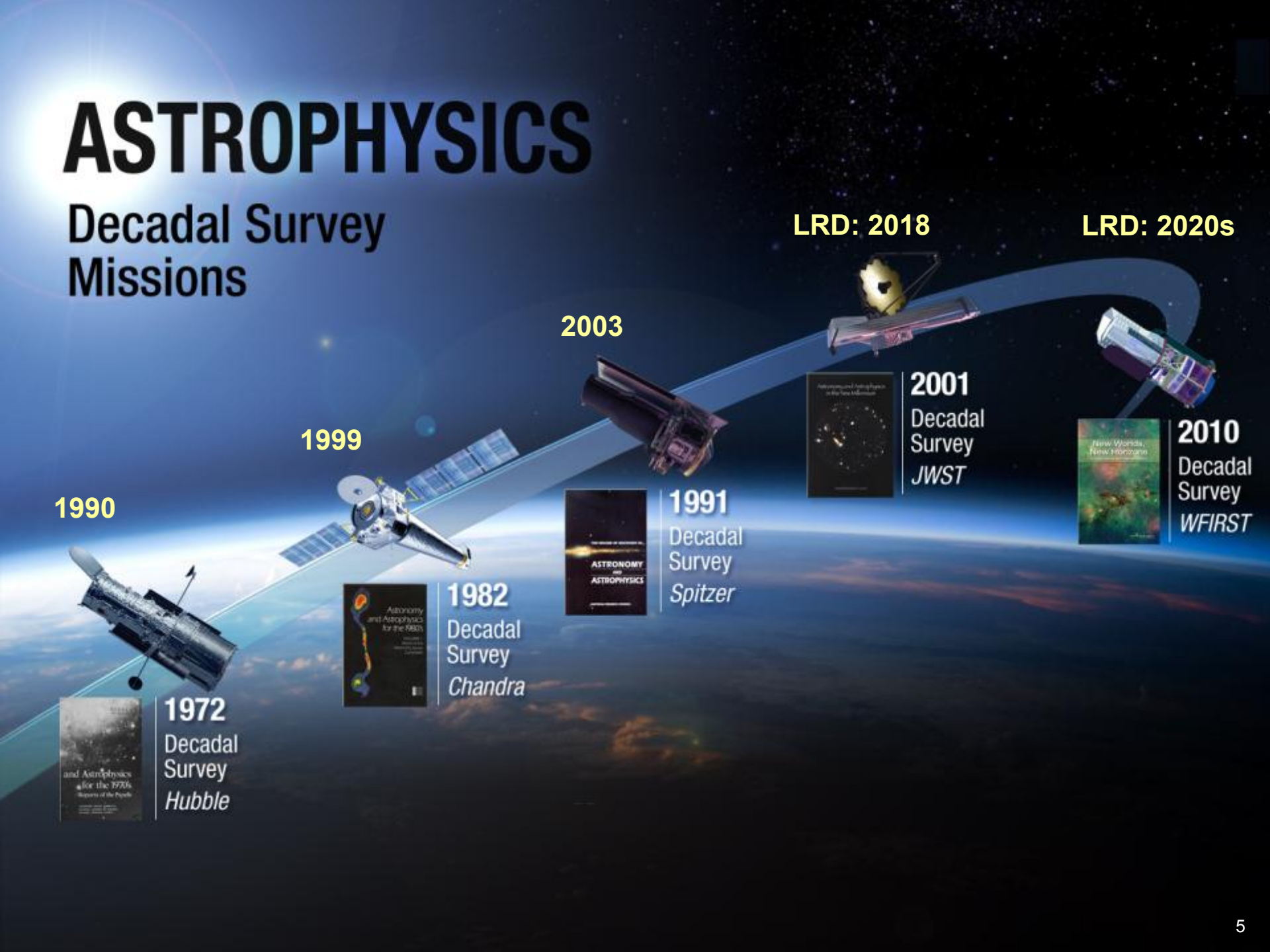
1. Probe the origin and destiny of our universe, including the nature of black holes, dark energy, dark matter and gravity.
2. Explore the origin and evolution of the galaxies, stars and planets that make up our universe.
3. Discover and study planets around other stars, and explore whether they could harbor life.

Decadal Survey Priority

Priority 1 (Large, Space).
Wide-Field Infrared Survey Telescope

A wide-field-of-view near-infrared imaging and low-resolution spectroscopy observatory will tackle the most fundamental questions in astrophysics:

- Why is the expansion rate of the universe accelerating?
- Are there other solar systems like ours, with worlds like Earth?
- How do galaxies, stars, and black holes evolve?


ASTROPHYSICS
Decadal Survey
Missions
LRD: 2018
LRD: 2020s
2003
1999
1990
2001
Decadal
Survey
JWST
2010
Decadal
Survey
WFIRST
1991
Decadal
Survey
Spitzer
1982
Decadal
Survey
Chandra
1972
Decadal
Survey
Hubble

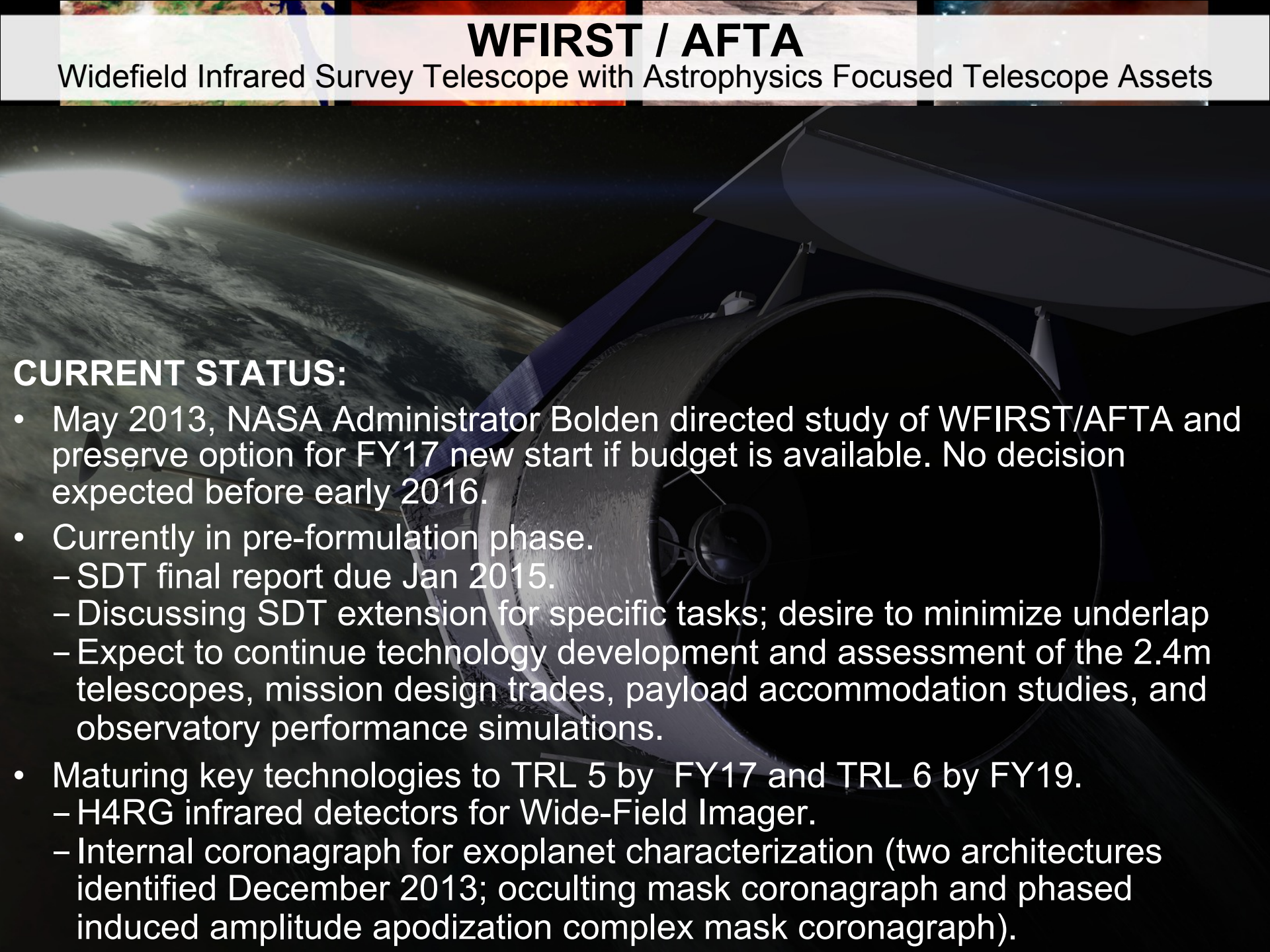
WFIRST / AFTA

Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

- Recent NRC study on WFIRST/AFTA offers positive view of AFTA, with concerns about technology and cost risks.
- FY14 appropriation ($56M) supported pre-formulation of WFIRST/AFTA, including significant ramp-up of technology development for detectors and coronagraph (with STMD). Technology risk reduction progressing well.
- FY15 request ($14M) supports Agency/Administration decision for formulation to begin NET FY 2017, should funding be available. Cautious optimism.

WFIRST / AFTA

Widefield Infrared Survey Telescope with Astrophysics Focused Telescope Assets

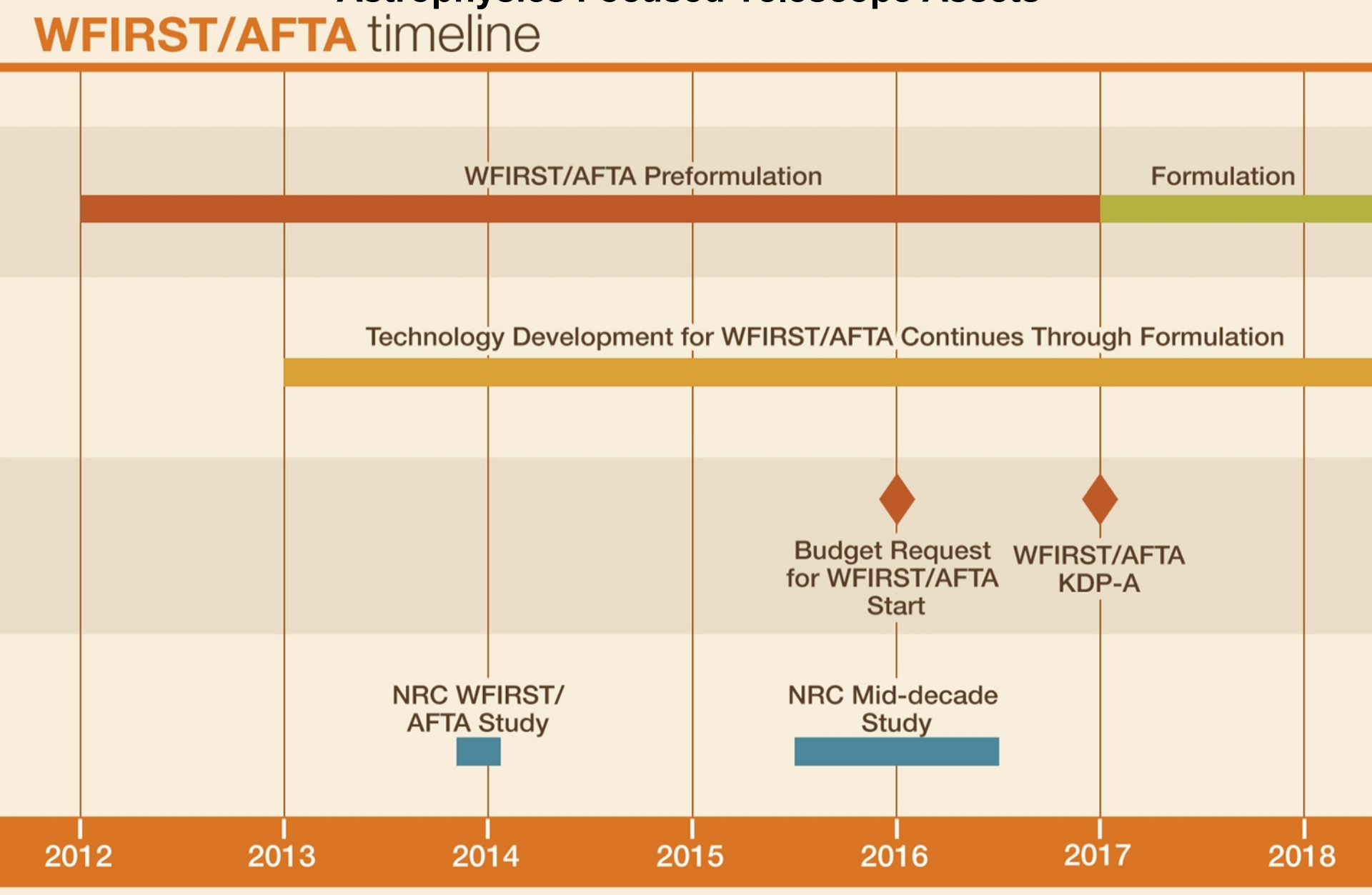


CURRENT STATUS:

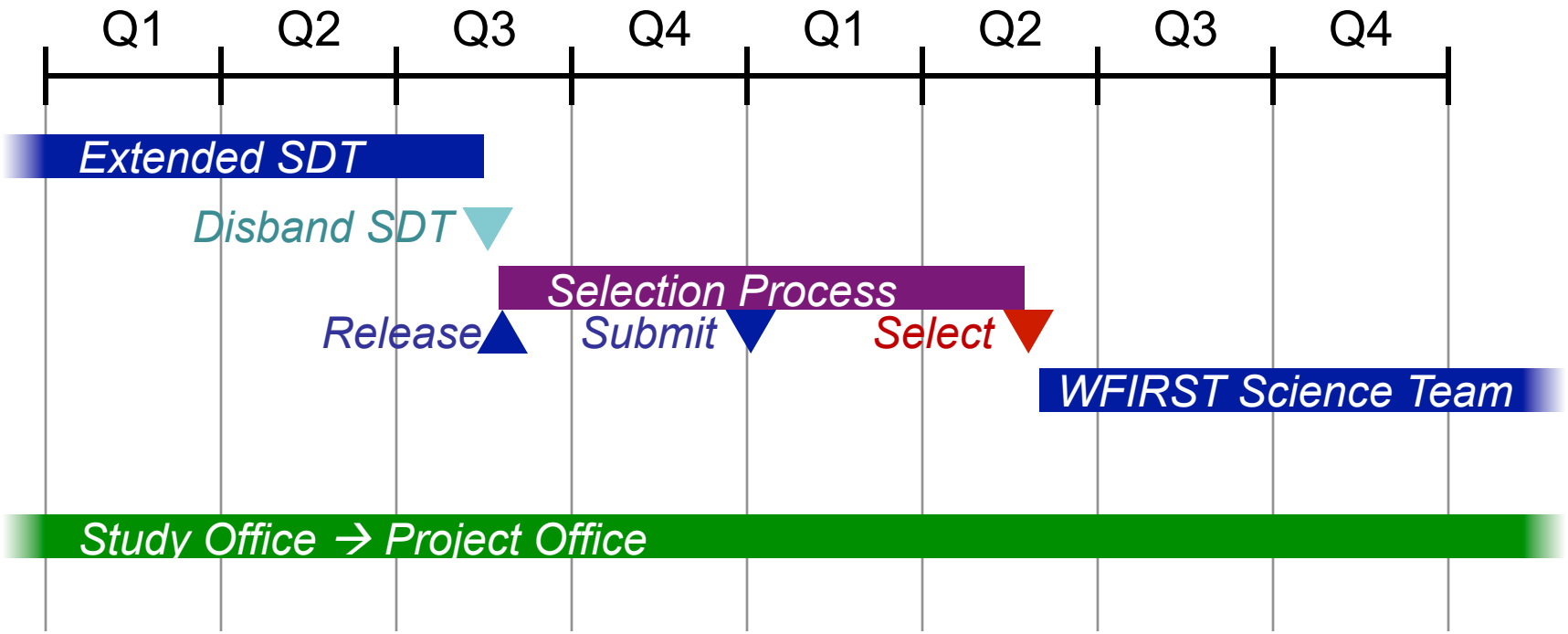
- May 2013, NASA Administrator Bolden directed study of WFIRST/AFTA and preserve option for FY17 new start if budget is available. No decision expected before early 2016.
- Currently in pre-formulation phase.
  - SDT final report due Jan 2015.
  - Discussing SDT extension for specific tasks; desire to minimize underlap
  - Expect to continue technology development and assessment of the 2.4m telescopes, mission design trades, payload accommodation studies, and observatory performance simulations.
- Maturing key technologies to TRL 5 by FY17 and TRL 6 by FY19.
  - H4RG infrared detectors for Wide-Field Imager.
  - Internal coronagraph for exoplanet characterization (two architectures identified December 2013; occulting mask coronagraph and phased induced amplitude apodization complex mask coronagraph).

Plan for WFIRST/AFTA Preformulation

Widefield Infrared Survey Telescope using Astrophysics Focused Telescope Assets



Science Team Selection



WFIRST Preparatory Science

- New ROSES 2014 Element for WFIRST/AFTA, announced April 21.
- Purpose: bridge from basic theory to observational modeling.
- Proposals must be both:
  - Relevant to WFIRST's primary astrophysics goals.
  - Predominantly WFIRST-specific development of detailed simulations and models.
- 53 Proposals received on July 11. Covered all areas of WFIRST science including supernovae, galaxy redshift surveys, weak lensing, exoplanet microlensing, coronagraphy, and other science.
- Intend to select ~12 proposals, total $1.8M in first year.
- Intend to select a range of scales (smaller and larger) and periods of performance (1, 2, 3 yr).
- Investigators selected will coordinate efforts with WFIRST Study Office and WFIRST/AFTA Science Definition Team.
  - Annual summary white paper on progress.

The Big Picture

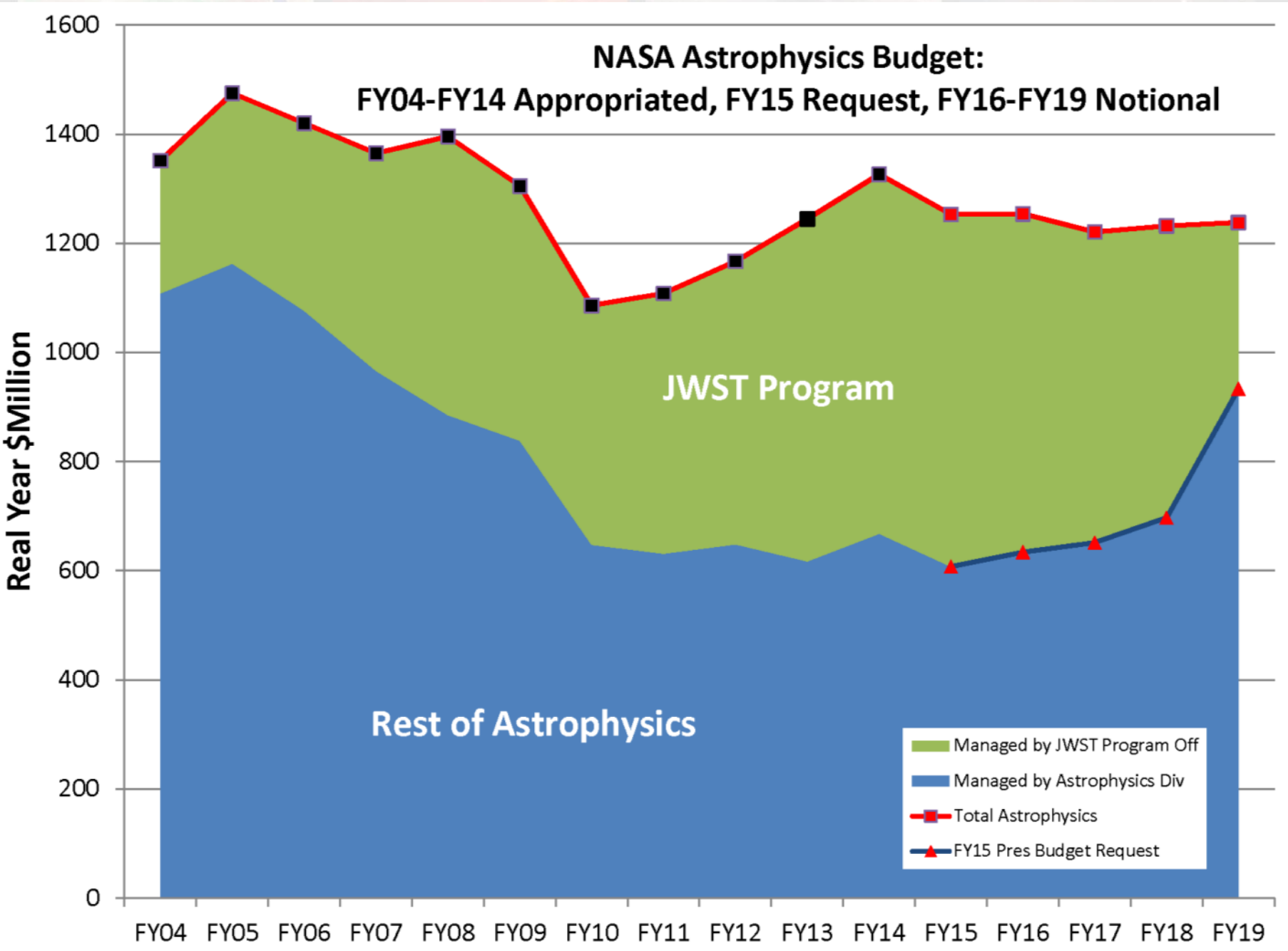
- We are addressing decadal priorities within budget constraints.
  - The budget for NASA astrophysics, which includes JWST, continues at $1.33B in FY14; the President has requested $1.25B in FY15 (the difference is mostly due to deletion of SOFIA from FY15 budget request).
  - JWST, the highest priority of the community, is making progress, remains on schedule, and is fully funded for an October 2018 launch.
  - NASA is preparing for a strategic Astrophysics mission to follow JWST as soon as funding becomes available. Preformulation of WFIRST/AFTA was funded in FY14 appropriation and is included in FY15 budget request.
  - SOFIA has completed development and has entered its operations phase.
  - NASA is developing new Explorer missions (NICER, TESS) and contributions to our international partners (LPF, ASTRO-H, Euclid).
  - NASA is discussing contributions to ESA's Athena and L3 GW observatory.
  - NASA is planning a robust Astrophysics Explorers Program with a SMEX AO in late CY2014 and an EX AO in ~FY2017.
  - Following the 2014 Senior Review, NASA plans to continue operating all currently operating missions, including Spitzer.
  - NASA continues to support individual investigators for data analysis, theory, and technology investigations through open, competitive, peer reviews.
- The budgetary future remains uncertain.
  - Priorities must be used to guide difficult budget choices.
  - The FY2015 budget request represents a ~10% decrease for the Astrophysics Division in FY15; the cost of operating SOFIA can not be accommodated within this reduced budget.

FY15 President's Budget Request

Outyears are notional

($M)	2013	2014	2015	2016	2017	2018	2019
Astrophysics	$617	$668	$607	$634	$651	$697	$993
JWST	$627	$658	$645	$620	$569	$535	$305

- **Supports pre-formulation of WFIRST/AFTA**, including technology development for detectors and coronagraph.
- Supports a growing Astrophysics Explorer program with continued development of ASTRO-H, NICER, and TESS, and initiation of the next Small Explorer mission.
- Supports operating missions: Hubble, Chandra, and other missions rated highly by the 2014 Senior Review.
- Continues a competed astrophysics research program and support of the balloon program.
- Seeks to work with current partner Germany and potential partners to identify a path forward for SOFIA with greatly reduced NASA funding. Unless partners are able to support the U.S. portion of SOFIA costs, **NASA will place the aircraft into storage by FY 2015**.
- **Supports the commitment to an October 2018 launch date for JWST**. Continues manufacturing of the flight sunshield structure and membranes. Completes and delivers the flight cryogenic cooler tower assembly. Delivers the Optical Telescope Element flight structure. Initiates integration of the 18 flight primary mirror segments. Conducts the final Integrated Science Instrument Module level cryo-vacuum test.


NASA Astrophysics Budget:
FY04-FY14 Appropriated, FY15 Request, FY16-FY19 Notional
Real Year $Million
1600
1400
1200
1000
800
600
400
200
0
JWST Program
Rest of Astrophysics
Managed by JWST Program Off
Managed by Astrophysics Div
Total Astrophysics
FY15 Pres Budget Request
FY04
FY05
FY06
FY07
FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
FY18
FY19

FY15 Budget Appropriation Status

- Administration request is $607M for Astrophysics and $645M for JWST.
- House appropriations bill and report includes:
  - Recommendation is $680M for Astrophysics ($73M⬆) + $645M for JWST
  - Restores $5M reduction in Hubble operations
  - **Does not provide specific guidance for WFIRST**
  - Rejects SOFIA termination; appropriates $70M ($58M⬆) for SOFIA ops
  - Provides $30M ($15M⬆) for EPO
- Senate appropriations committee markup and report includes:
  - Recommendation is $750M for Astrophysics ($143M⬆) + $645M for JWST
  - Restores $23M reduction in Hubble operations
  - **Provides $56M for WFIRST ($42M⬆)**
  - Rejects SOFIA termination; appropriates $87M ($75M⬆) for SOFIA ops
  - Provides $42M ($27M⬆) for EPO
- Continuing Resolution through December 11, 2014…

FY15 Planned Accomplishments

- The **TESS** Explorer Mission will be confirmed to begin implementation (KDP-C) in FY15.
- The **ISS-CREAM** experiment will be launched to the International Space Station (KDP-E) in FY15.
- The Step 1 selection (KDP-A) will be made for the next Small Astrophysics **Explorer** and Explorer Mission of Opportunity in FY15.
- ESA's **LISA Pathfinder** with NASA's ST-7 experiment will launch (KDP-E) in FY15.
- The **WFIRST/AFTA** science definition team report will be completed in FY15.
- Manufacture, assembly, and test of the **Euclid** flight detectors will continue in FY15.
- JAXA's **ASTRO-H** mission spacecraft system level test will take place in FY15.
- The Astrophysics **Archives Senior Review** will be held in FY15.
- **Hubble** will achieve 25 years of operation in FY15.
- The NRC **Mid-Decade Review** will begin in FY15.
- Four **Balloon** campaigns will be conducted in FY15.
- Five **Sounding Rockets** with Astrophysics payloads will launch in FY15.

Planning for the 2015-2016 Mid-Decade Review

- The Mid-Decade Review will be conducted during 2015-2016
  - Discussions of the Statement of Task are underway with the NRC.
  - Study will be co-sponsored by NASA, NSF, and DOE (the Agencies)
- In NASA's opinion, the mid-decade review will
  - Describe most significant scientific discoveries, technical advances, and relevant programmatic changes over the last 5 years
  - In the context of the reduced funding circumstances, assess the Agencies' responses, including plans and progress, to the Decadal Survey
  - In the context of other NRC reports and Federal Advisory Committee reports, identify any actions that could be taken to maximize the science return of the Agencies' programs including dealing with any mid-decade contingencies described in the Decadal Survey.
  - Not revisit or alter the scientific priorities or mission recommendations in the Decadal Survey and related NRC reports.
- Is there anything we should do, other than continue implementing our plan, to prepare for mid-decade review?

NASA/NSF Partnership for Exoplanet Research

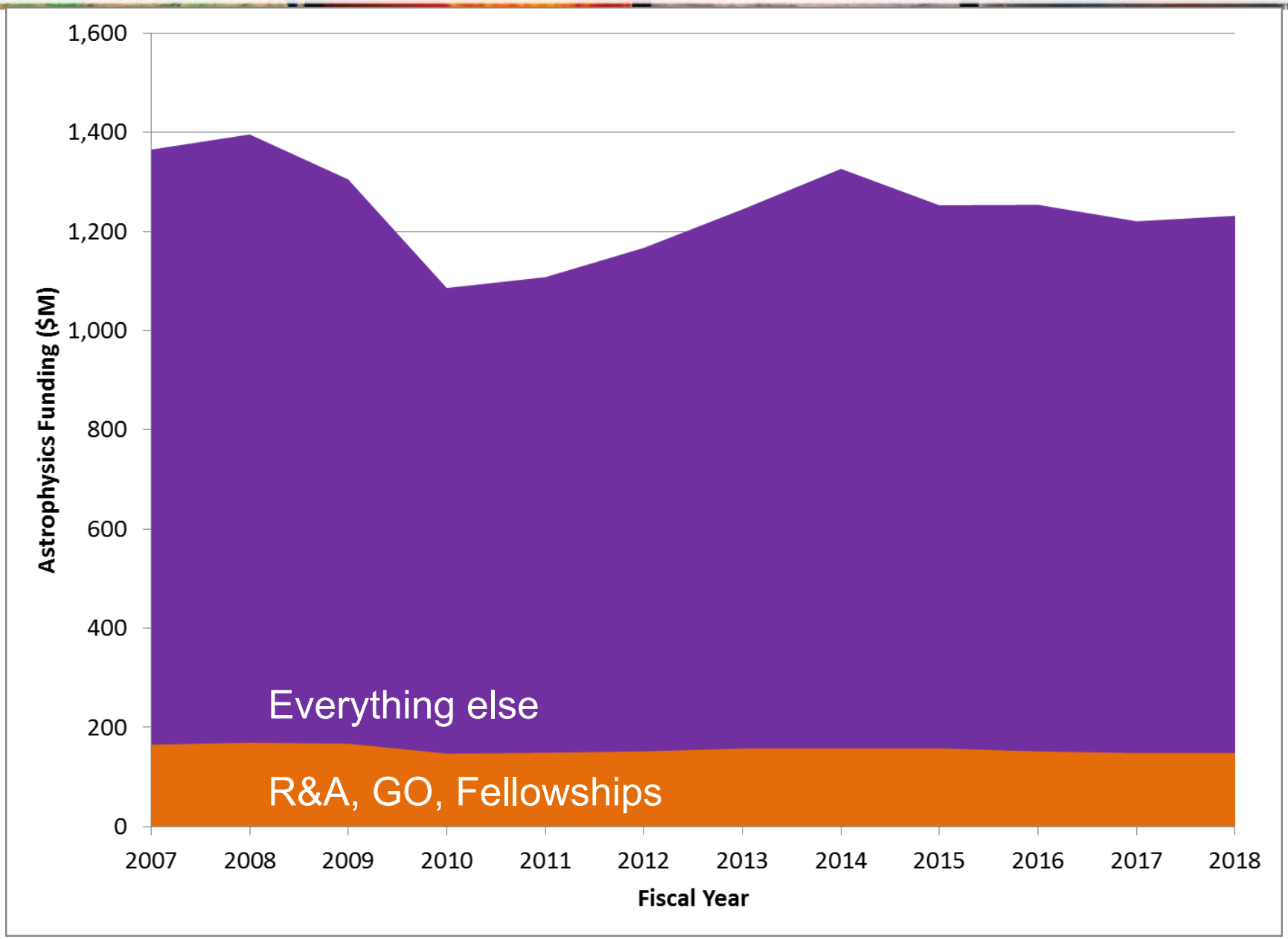
- New Worlds, New Horizons:

  "*NASA and NSF should support an aggressive program of ground-based high-precision radial velocity surveys of nearby stars to identify potential candidates … for a future space imaging and spectroscopy mission*".
- NASA Motivation: To provide US astronomical community with open access to a world-class precision radial velocity facility instrument that will enable:
  - follow-up observations in support of current NASA missions (e.g. K2, TESS, JWST)
  - pathfinder observations to inform the design and operation of future NASA missions (e.g. **WFIRST-AFTA**, NWNH "*New Worlds Mission*")
- Primary objective is to enable a community based exoplanet research program in support of NSF research interests and NASA mission goals (e.g. Kepler, K2, TESS, etc.).
- Partnership proposes to capitalize on the NOAO share of the WIYN consortium to implement a joint exoplanet research program that ultimately will focus on high precision radial velocities.

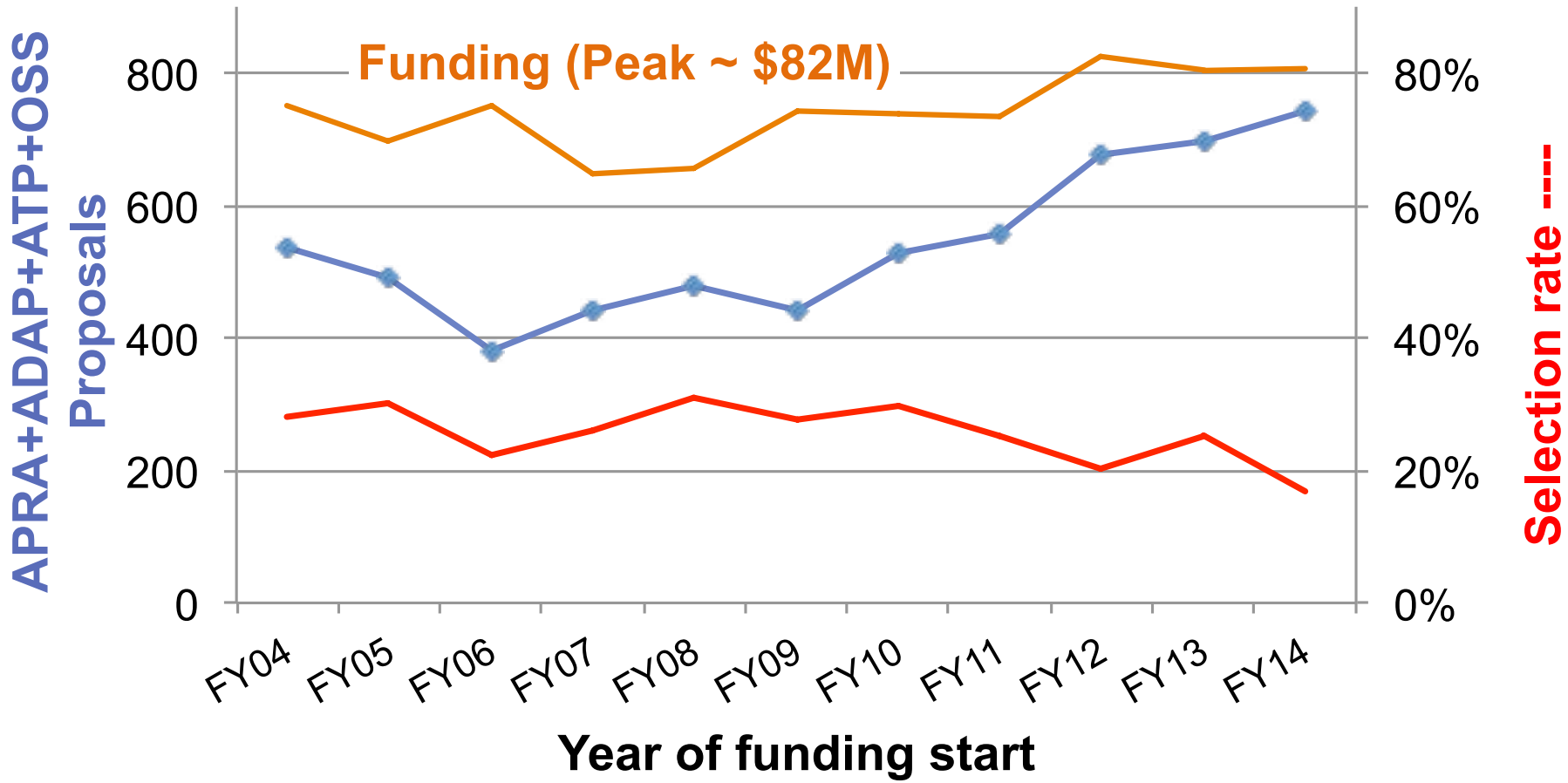
NASA/NSF Partnership for Exoplanet Research

- The program, as currently envisioned, would be carried out in two stages:
  - Stage 1. FY2015 – FY2018
    - Manage an exoplanet-targeted Guest Observer program with existing instrumentation on WIYN using NOAO share (40%) of WIYN time.
    - NASA to release solicitation for a facility-class extreme precision radial velocity spectrometer (EPRVS) for the WIYN telescope; goal of commissioning in 2018.
  - Stage 2. FY2018 – TBD
    - Manage an exoplanet-targeted GO and guaranteed time program at WIYN with EPRVS instrument and existing instrumentation on WIYN
    - Develop and maintain a data management system to serve EPRVS data products.
    - Provide open community access to a cutting edge EPRVS instrument for observations that support NASA missions.
- Anticipated timeline for EPRVS:
  - Early December 2014 – issue community announcement of plan for a NASA solicitation for the construction of an EPRVS.
  - Early January 2015 – release of EPRVS solicitation as amendment to ROSES 2014 NRA
  - April 2015 – EPRVS proposal submission deadline
  - August 2015 – announcement of selection, initiation of project
  - FY2018 – commissioning of EPRVS and beginning of operations

Community Funding vs Total Budget



Astrophysics ROSES selection rates



AAAC task force on R&A and demographics being led by Prisca Cushman (U. Minn).

GO Funding: 1990-2018 (projected)